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INDUSTRIAL COMMODITIES IN UTAH

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FROM THE DIRECTOR'S DESK

Sand and Gravel — a surprisingly scarce resource

SAND and gravel are literally the building blocks of our communities. There is a growing concern that their continued availability is jeopardized by the expansion of the very residential developments they make possible. Nowhere is this irony more apparent than along the Wasatch Front. This article provides a brief overview of the use of sand and gravel in Utah, describes the resource, identifies the conflict and recommends that these resources be identified so that communities can consider their value.

DEMAND

Sand and gravel provide the building blocks for our society...highways, concrete blocks, dams, foundations, paving, airport runways, and general construction. The pioneers who settled Utah began, almost as soon as they arrived, mining sand to make mortar to build their stone and adobe houses. Later, they improved their dirt roads by covering them with sand and gravel and soon a growing cement industry required sand and gravel for aggregate. By 1973, production reached a high of 15 million tons and in 1983 production was approximately 12 million tons with a value of 20 million dollars. By value and by amount produced, this ranks in the top five non-fuel mineral commodities produced in Utah. Considering that Utah is one of the fastest growing states in the nation and the population growth stimulates construction of homes, support facilities and transportation networks, sand and gravel will remain important to Utah's economy.

SUPPLY

For Utah's economy to have relatively inexpensive aggregate for making concrete, there have to be high-quality deposits located near the market areas. A high quality aggregate deposit is: relatively clean (containing only small amounts of organic matter, mica, silt, clay, chemical salts, and mineral coatings which weaken the bond with the cement paste; tough and resistant to abrasion (well indurated rocks make the best gravel...quartzites, fresh granite, gneiss, limestone, dolomite and basalt); well graded and rounded (because they require less cement for bonding); non-chemically reactive, non-soluble and resistant to oxidation (undesirable are opal, chalcedony, siliceous volcanics, some phyllites and rocks coated with or containing opal, chalcedony, and iron sulfides).

Utah's greatest volumes of high-quality sand and gravel were deposited along the shores of Lake Bonneville. Impressive volumes were deposited especially at the Bonneville and Provo levels where the lake remained sufficiently long for coarse gravel deposits to be developed on gentle beaches where storm waves would winnow out the sand, for spits and bars to be formed by long shore currents, such as at Point of the Mountain and at Stockton, Utah, and for huge deltas to build up where major rivers entered the lake, such as at Ogden, Utah at the mouth of Weber Canyon and at Brigham City. Millions and millions of tons of sand and gravel were laid down along various segments of the shorelines of Lake Bonneville.

CONFLICT

These shoreline areas are now some of the choicest residential properties along Utah's urban corridor. Excellent gravel deposits underlie residential areas such as Federal Heights, Fruit Heights and the East Bench. University campuses such as the University of Utah, Brigham Young University, Weber State University and Utah State University are built on these old beach deposits. In 1971, the Utah Department of Transportation inventoried these materials and estimated only 155 million tons remained for mining. They concluded that urbanization was excluding these resources from future use faster than mining was extracting them for construction purposes. They estimated that unless economic or social conditions changed by 1990, the once-abundant resources along

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INDUSTRIAL COMMODITIES IN UTAH

By BRYCE T. TRIPP

THE term "industrial rocks and minerals" applies to all geological commodities which are not exclusively processed into metals and are not used as fuels. Some of them are of low unit value and hence cannot be shipped great distances economically. They are also low-profile commodities; people generally have little appreciation for just how ubiquitous industrial minerals are and how large an industry they comprise. For example, in 1973, a phenomenal 774 million short tons of limestone were quarried in the United States and used in thousands of products ranging from cement to chewing gum (Boynton, 1980, p. 95, 114)

Utah contains a wide variety of these industrial rocks and minerals. The most important industrial commodities produced in Utah, as ranked in decreasing order of dollar value according to USBM 1983 production figures, were Portland cement, potassium salts, halite, phosphate, construction sand and gravel, and lime (including quicklime and slaked lime). A brief summary of these and other important industrial commodities is included below accompanied by two figures and a table. Figure 1 shows areas of the State that contain selected deposits of industrial commodities; sand and gravel and other commodities that are very common are not included in figure 1. Figure 2 and table 1 together give locations and other specific information for the larger quarries, pits, and plants (construction sand and gravel not included). The locations in table 1 are grouped by commodity. Different plants, pits, and quarries of the same company are also grouped; for example, locations 4 through 4d all belong to Interstate Brick's heavy clay operations.

PORTLAND CEMENT

Portland cement is currently produced by three operators: Ideal Basic Industries, Lone Star Industries, and Southwestern Portland Cement.The three companies each utilize slightly different techniques and ingredients to manufacture their cement but the basic process consists of combining limestone; a source of alumina, like shale; a source of silica, like quartzite or sandstone; and a small amount of iron. This mixture is then ground, fused in a kiln into "clinker," and then reground with a small amount of gypsum (used to slow the cement setting time) to form the final product. Natural "cement rock" like the Twin Creek Limestone contains the proper proportions of lime, alumina, and silica to form the bulk of the kiln feed by itself.

Ideal Basic Industries uses Jurassic Twin Creek Limestone, along with the Triassic-Jurassic Nugget Sandstone, gypsum from the Arapien Shale (Cox Enterprises), and iron-rich slag from Rocky Mtn. Energy (Kennecott slag) at its 350,000-ton-per-year (TPY) Devil's Slide plant. Fuel utilized is coal with natural gas backup. Oil well (Class G) cement accounts for 40 percent of their production (Sommers, 1985).

Lone Star Industries (Portland Cement Company of Utah) utilizes Twin Creek Limestone sweetened with high-calcium limestone from the Mississippian Great Blue Limestone. Gypsum is from the Jurassic Arapien Shale (Thomas J. Peck and Sons) and iron is from Nucor Steel mill scale. Fuel used at the 400,000 TPY plant is coal with natural gas backup. Oil well (Class H) cement comprises about 15 percent of their production (DeLong, 1985).

Southwestern Portland Cement is currently leasing the recently constructed $85 million, 650,000 TPY, Martin-Marietta plant near Delta, Utah. This plant uses limestone and shale from the Cambrian Ophir Formation, silica from the Cambrian Tintic Quartzite, iron-rich slag from Rocky Mountain Energy (Kennecott slag), and gypsum from the Arapien Shale (Thomas J. Peck and Sons). Fuel used is coal with oil backup.

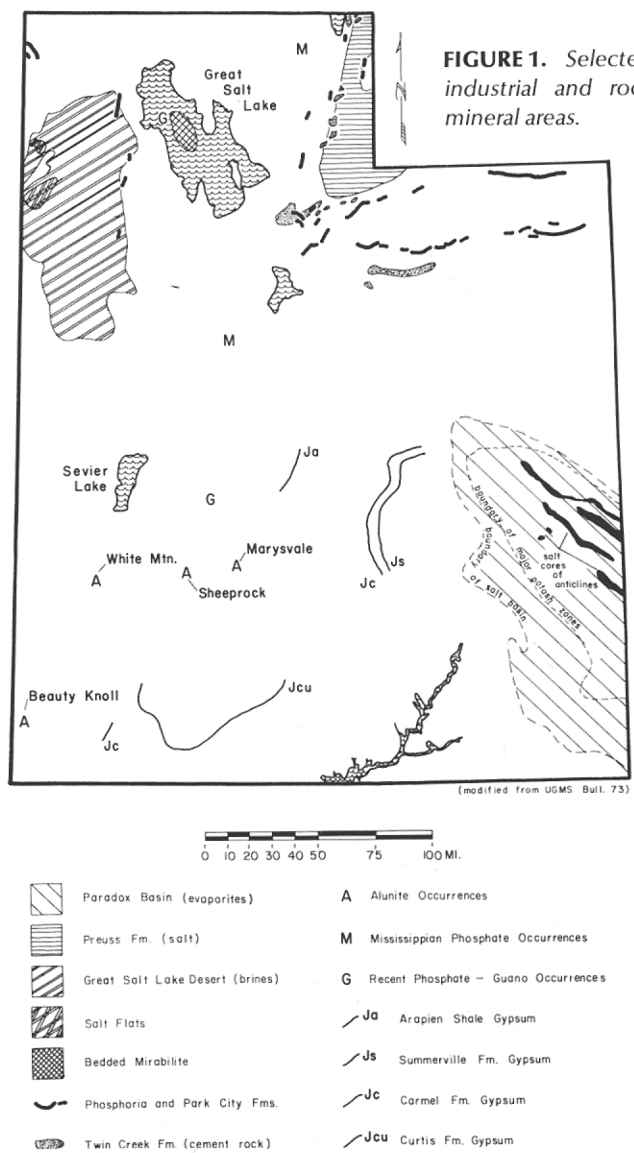

FIGURE 1. *Selected industrial and rock mineral areas.*

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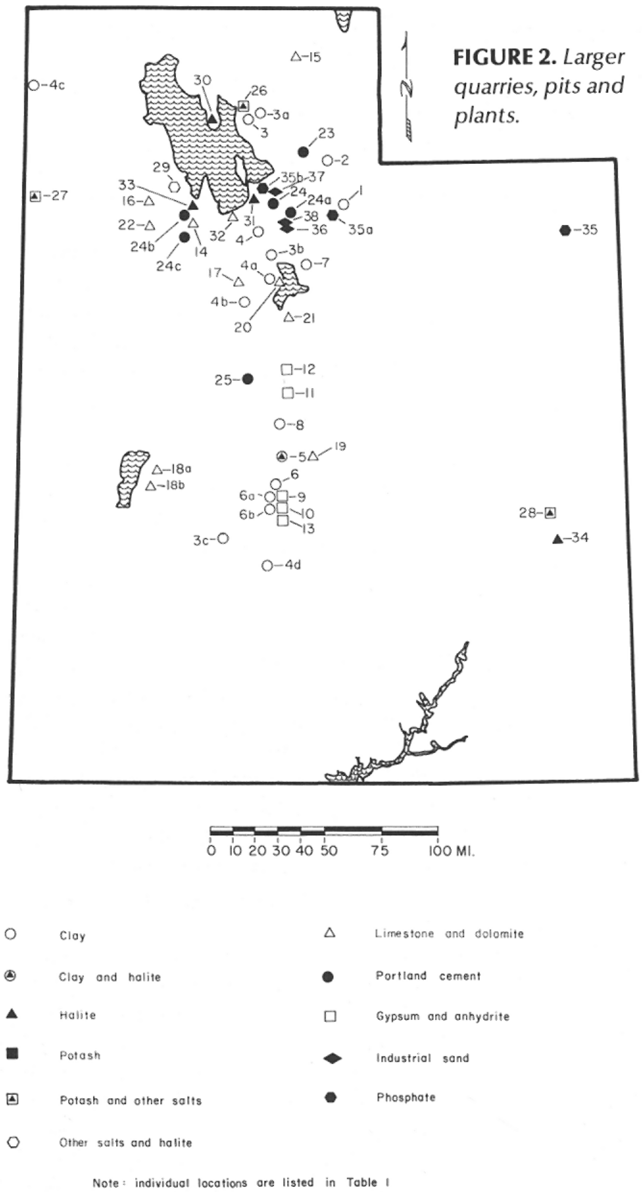


FIGURE 2. *Larger quarries, pits and plants.*

NON-HALITE SALTS

Non-halite salts are found in significant quantities at five localities: the Paradox Basin, southwestern Utah alunite deposits, Sevier Lake, Great Salt Lake Desert, and the Great Salt Lake.

A large area of the Paradox Basin is underlain by bedded sylvite and carnallite with associated subsurface brines. The potash resource occurs in 18 of 29 evaporite cycles in the Pennsylvanian Paradox Formation of the Hermosa Group. Eleven of the cycles contain significant amounts of potash (UGMS, 1964, p. 208) especially where diapirism has increased thickness and decreased overburden. Texasgulf currently produces about 300,000 TPY from a hybrid underground/solution mine at Cane Creek anticline, near Moab, Utah. Production is from sylvite horizon five near the top of salt horizon five in the Paradox Formation (Texasgulf, 1985). The mine which was opened in 1964 as an underground mine was converted in 1971 to solution mining due to the convoluted nature of the salt beds (Phillips, 1975). Buttes Resources has announced plans to develop a solution potash mine in the Moab area (Utah Mining Association, 1985).

Utah contains the largest alunite resource in the United States. The largest of the deposits, the White Mountain deposit, a replacement type deposit, contains an estimated reserve of 232 x 10^6 tons of 33 percent alunite with a resource of 402 x 10^6 tons of 28 percent alunite (Hall, 1978) and was the object of some recent exploration. The Marysvale vein and replacement deposit, a distant second in size to the White Mtn. deposit, was the site of small World War I and II production from the high-grade veins. Alunite is a potential source of potash and aluminum.

Sevier Lake, dry through most of historical time but currently the second largest lake in Utah, contains subsurface brines assaying slightly less than 200 grams/liter total dissolved solids (TDS). In comparison with typical Great Salt Lake surface brines, Sevier Lake brines are less concentrated, have a higher sulphate to chloride ratio, and a lower magnesium content. Lithium and bromine content are negligible (Whelan, 1969, p.5,12).

The Great Salt Lake Desert is a large area in northwest Utah which is partially underlain by subsurface brines and which has two salt encrusted areas (salt flats). This salt resource is the residue of the evaporation of Lake Bonneville, a Pleistocene lake. The southern salt flats, the famous Bonneville Salt Flat of world land speed record fame, is the home of the Kaiser Aluminum and Chemical solar potash plant where potassium and magnesium chloride are currently produced from brines of three shallow subsurface aquifers. The shallowest aquifer, generally less than twenty feet deep, provides most of the brine which is gravity drained into collection ditches and then pumped into solar ponds for evaporation to produce sylvinite. The sylvinite is then harvested and processed into sylvite by milling and froth flotation. Potash production in 1980 was 85,000 tons of potassium chloride (Gwynn, 1980, p. 229). Magnesium capacity in 1983 was 50,000 tons MgO equivalent (Burgin, 1983, p. 12).

The salt resource of the Great Salt Lake consists of a concentrated surface brine and a localized subsurface, bedded salt.

The two Great Salt Lake operations that utilize surface brine to produce salts other than halite are: AMAX Magnesium which produces a magnesium chloride brine which is used in the production of magnesium metal and chlorine gas (Gwynn, 1980, p. 219), and Great Salt Lake Minerals and Chemicals which concentrates the brines through solar evaporation and from that produces mirabilite (through winter cooling of the brine) and potassium and magnesium salts and magnesium chloride brine (Gwynn, 1980, p. 224).

A large area of the bed of the Great Salt Lake is underlain by a shallowly buried bed of mirabilite or Glauber's salt, a hydrated sodium sulfate. This wedge-shaped deposit thickens from zero feet thick on the west to thirty-two feet thick on the east and is overlain by twenty to twenty-five feet of lake sediments (Eardley, 1962). It was discovered during construction of the railroad causeway in 1903 but has never been exploited.

HALITE

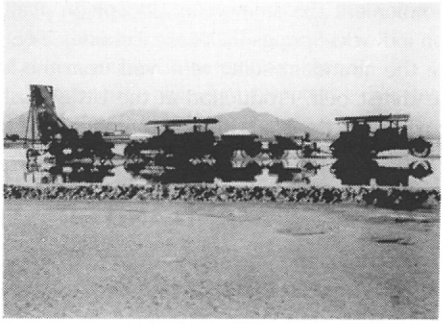
Significant halite resources are found at seven localities: the Paradox Basin, where some salt is recovered by solution mining at Texasgulf, and at the Moab Brine Company, which markets an oil well drilling brine; the Jurassic Arapien Shale in Sevier Valley where salt is open-pit mined by Redmond Clay and Salt predominantly for livestock salt; Sevier Lake, which contains brines which haven't yet been commercially developed; the Great Salt Lake Desert, which contains brines which also aren't currently exploited for halite; the Jurassic Preuss Sandstone, which contains a poorly defined salt resource; the newly discovered Tertiary salt beds of west-central Utah, near Delta, Utah; and the Great Salt Lake.

Table 1. Selected quarries, pits, and plants

Location	Name	Location Twn.,Rng.,Sec.	Commodity	Age/Formation	Use/Products
1	Utelite Plant and Quarry	1S., 5W., 5,8	clay	Cret. Frontier Fm.	bloated for lightweight aggregate
2	Anderton Pits	4N., 4E., 33	clay	Cret. Henefer Fm.	brick, tile
3	Interpace Plant and Pit	6N., 1W., 6	clay	Rec. Alluvium	brick, flue tile
3a	Pleasant View Pit	7N., 2W., 13	clay	Cambrian/Precambrian Weathered Schist	brick, flue tile
3b	Clinton Pit	5S., 1W., 8,9	clay	Miss. Manning Canyon Shale	brick, flue tile
3c	Fullmer Pit	26S., 4.5W., 30	clay	Tert. Joe Lott Tuff (altered)	brick, flue tile
4	Interstate Brick West Jordan Plant	3S., 2W., 12	—	—	—
4a	Pelican Point Pits	6-7S., 1E.-1W.	clay	Miss. Manning Canyon Shale	brick, tile
4b	Fivemile Pass Pits	7S., 3W., 4,5	clay	Miss. Manning Canyon Shale	brick, tile
4c	Montello Pits	9N., 17W., 7 9N., 18W., 12	clay	Tert. Salt Lake Fm.	brick, tile
4d	Koosharem Pits	27S., 2W., 2,11	clay	Tert. Dry Hollow Fm.	brick, tile
5	Redmond Clay and Salt Pits	20S., 1W., 14,23, 24,25	halite; bentonite	Jur. Arapien Shale	livestock salt, table salt; waterproofing, drilling clay
6	Western Clay Co. (Aurora Plant)	22S., 1W., 4	—	—	—
6a	Aurora Pit	21S., 1W., 31	Fuller's earth	Tert. Bald Knoll	filtration
6b	Redmond Pit	21S., 1W., 2	bentonite	Jur. Arapien Shale	waterproofing
7	R.D. Wadley Pit	5S., 2E., 9	clay	Miss. Long Trail Shale	fire clay
8	Azome Utah	17S., 1W., 3-5	clay	Tert. Goldens Ranch Fm.	livestock feed supplement
9	Georgia Pacific	22-23S., 1-2W.	gypsum	Jur. Arapien Shale	wallboard, plaster, fire-proof doors, agricultural gypsum
10	U.S. Gypsum	22S., 1W., 14,15, 22,23, 22S., 2W., 36 23S., 2W., 1	gypsum	Jur. Arapien Shale	wallboard, joint compound
11	Cox Enterprises	14S., 1E., 33,34	gypsum	Jur. Arapien Shale	Portland cement retarder
12	T.J. Peck and Sons	12S., 1E., 27 13S., 1E., 3	gypsum	Jur. Arapien Shale	Portland cement retarder, agricultural gypsum
13	Western Clay	22-23S., 1-2W.?	gypsum/anhydrite	Jur. Arapien Shale	coal mine dusting
14	Genstar	1S., 7W., 25	dolomite	Ord. Fish Haven Dol. Sil. Laketown Dol.	hydrated lime, quicklime, crushed stone
15	Legrand Johnson	11N., 2E., 16,17	limestone	Miss. Great Blue Ls.	limestone for sugar processing, crushed stone
16	Utah Marblehead	1N.,9W.,32	limestone	—	hydrated lime
17	Kennecott	6S., 3W., 7	limestone	Miss. Great Blue Ls.	flux
18	Continental Lime	21S., 10W., 36	limestone	Camb. Dome Fm.(?)	quicklime, crushed stone
19	Western Clay Limestone Pits	21S., 1E., 8	limestone	Tert. Flagstaff Ls.	coal mine dusting
20	Cedarstrom Clay and Calcite	6S., 1E., 30	calcite	Miss. Deseret Fm.	poultry grit, livestock feed supplement
21	U.S. Steel	9S., 1E., 27	limestone	Camb. Herkimer Ls., Bluebird Dolo., Cole Cyn. Dolo.	flux, coal mine dusting, crushed stone
22	Utah Calcium	1S. 10W., 23	calcite	Penn. Oquirrh Fm.	poultry grit, landscaping, building stone
23	Ideal Basic Industries	4N., 4E., 19	cement rock, sandstone	Jur. Twin Creek Ls. Jur./Tri. Nugget Ss.	cement, crushed stone
24	Utah Portland Cement Plant	1N., 1W., 12	—	—	cement
24a	Parleys Cyn. Quarry	1S., 1E., 24	cement rock	Jur. Twin Creek Ls.	cement
24b	Flux Quarries	2S., 6W., 5,8 1S., 6W., 30,31	limestone	Miss. Great Blue Ls.	cement
24c	Little Mtn. Quarry	2S., 6W., 20	limestone	Miss. Great Blue Ls.	cement
25	Southwestern Portland Cement	14S., 3W., 33	limestone, shale, quartzite	Camb. Ophir Fm. Camb. Tintic Quartzite	cement
26	Great Salt Lake Minerals and Chemicals Corp.	6N., 3W., 6	brine	—	halite, sodium sulfate, potassium sulfate, magnesium chloride
27	Kaiser Aluminum and Chemical Corp.	1S., 19W., 14	brine	—	potassium chloride, magnesium chloride
28	Texasgulf Inc.	26S., 20E., 24	brine	Penn. Paradox Fm.	potassium chloride, halite
29	Amax Magnesium	2N., 8W., 10	brine	—	magnesium chloride, halite
30	Lake Crystal	6N., 6W., 25	brine	—	halite
31	Morton Thiokol	1S., 2W., 5	brine	—	halite
32	Domtar	1S., 4W., 34	brine	—	halite
33	American Salt Co.	1S., 6W., 22	brine	—	halite
34	Moab Brine Co.	26S., 21E., 1	brine	Penn. Paradox Fm.	drilling brine
35	Chevron-Little Brush Creek Mine	2S., 22E., 31	phosphate	Penn. Park City Fm.	superphosphoric acid, ammonium phosphate
35a	Phoston Terminal	2S., 5E., 6	—	—	—
35b	Garfield Plant	1S., 3W., 10	—	—	—
36	Salt Lake Valley Sand and Gravel	4S., 1W., 24	sand	Quat. Lake Bonneville Group	sand blasting sand
37	Rocky Mtn Energy	1S., 3W., 16,17	slag	—	sand blasting sand, railroad ballast
38	Blackhawk Slag Products	2S., 1W., 26	slag	—	sand blasting sand

There are six companies currently producing halite by solar evaporation of Great Salt Lake brine. These six, AMAX Magnesium, Great Salt Lake Minerals and Chemicals, Lake Crystal, Morton Thiokol, Domtar, and American Salt, produced the majority of the 936,000 short tons of halite reported by USBM (Burgin, 1984), in Utah for 1983. This production took place from a total Great Salt Lake halite resource probably in excess of four billion short tons (Gwynn, p. 155). The 1983 production figures were down sharply from the USBM's 1982 figure of 1,227,000 short tons (Burgin, 1984) due to heavy precipitation and an accompanying rise in the level of the Great Salt Lake. These types of fluctuations in lake level have been an obstacle to solar salt production on the Great Salt Lake since the establishment of a permanent salt industry there in 1850 (Gwynn, 1980, p. 203). The fortunes of the salt companies have varied with the lake level which has changed from an 1873 high of 4212 feet above mean sea level to a 1963 low of 4191 with an average elevation of 4202. The lake has risen almost continuously since 1963, with a meteoric rise starting in 1982 (Currey and others, 1983) that appears to be moderating in 1985. The lake elevation now stands at approximately 4209 and is down slightly from its 1985 peak of about 4210.

The rise in lake level has had a devastating effect on the salt companies. All operators lost some or all of their evaporation pond dikes. Many of the operations will have little or no salt production of their own this year but will obtain salt from Amax. Even if all the ponds were intact, there would still be a great impact on these businesses since the lake brines have been greatly diluted. South arm brines which contained 13 percent TDS in 1981 dropped



Harvesting potash, Utah-Salduro Potash Co, Bonneville Salt Flats, Utah (1918-1921).

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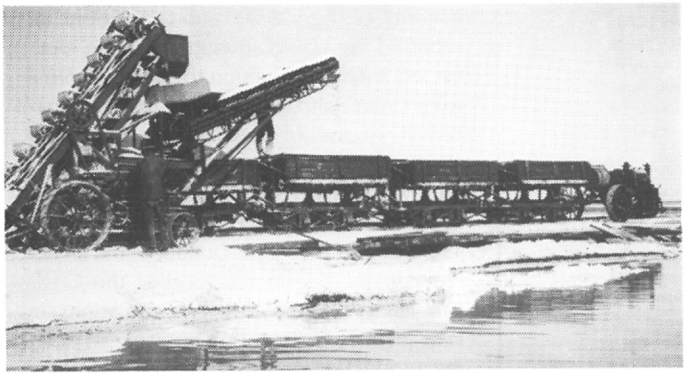
to 5.6 percent by 1984. North arm brines which contained 28 percent TDS in 1981 dropped to 17.8 percent by 1984 (Sturm, 1985). One producer, Lakeside (Domtar), recently sold their holdings on the lake to AMAX Magnesium.



Loading potash — Utah-Salduro Potash Co., Bonneville Salt Flats, Utah (1918-1921).

PHOSPHATE

Phosphate occurs in three modes in Utah; bat and bird guano which accounted for minor early production, Mississippian phosphatic shales which are minor and have not been exploited, and the intertongued Permian, Park City and Phosphoria Formations. The only present commercial operation is Chevron's Little Brush Creek mine where the Meade Peak phosphatic shale member of the Phosphoria intertongues with the Park City. Presently 550,000 TPY of concentrates are produced. One-third of the concentrates are sent directly by truck to Chevron's Garfield superphosphoric acid plant near Salt Lake City for acidizing. Acid was obtained from Kennecott until March of this year when the closure of Kennecott forced Chevron to turn to Asarco sources in Hayden, Arizona, El Paso, Texas, and Helena, Montana. The Garfield plant produces 55,000 TPY of superphosphoric acid and 55,000 TPY of ammonium phosphate (Salt Lake Tribune, 1985). Approximately two-thirds of the concentrates are trucked to Chevron's Phoston railhead in Wasatch Co. for shipment to Cominco in Canada.

The completion of a slurry pipeline from the Brush Creek Mine to Rock Springs, Wyoming by fall of 1986 will result in the closure of the Garfield plant (now operating at a loss due to expensive acid) and the construction of a new superphosphoric acid plant to complement the ammonium phosphate plant now under construction in Rocks Springs (Salt Lake Tribune, 1985). These plants will utilize the abundant sulfur removed from the "sour" gas produced in the thrust belt. Production at the Little Brush Creek Mine will approximately double with the completion of the pipeline (Worthen, 1985).

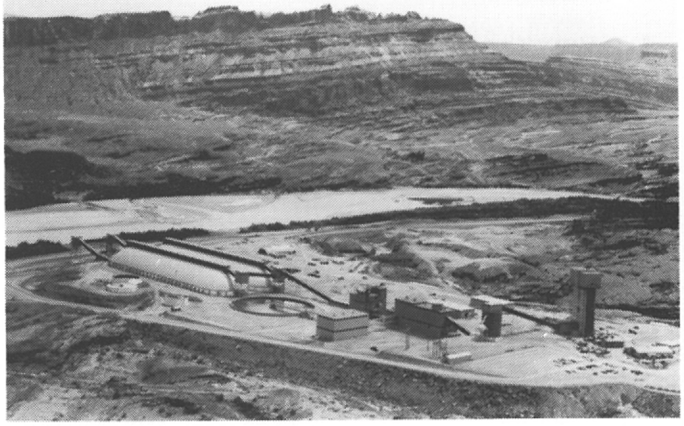
SAND AND GRAVEL

Most sand and gravel produced in Utah is for construction rather than industrial use. Of the hundred plus companies producing sand and gravel, only four producers of industrial sand are known: Monroc, Rocky Mountain Energy, Salt Lake Valley Sand and Gravel, and Blackhawk Slag Products. These four companies all produce specialty sand, primarily for sand blasting. Monroc and Salt Lake Valley Sand and Gravel produce from natural sands. Rocky Mountain Energy and Blackhawk Slag Products produce crushed material from Kennecott and Midvale smelter slags respectively.

Most natural sand and gravel production in Utah comes from Pleistocene Lake Bonneville shoreline deposits which cover a large part of western Utah. There are four major deposits or benches which mark long-lived stable water levels in the lake. The two highest benches, the Bonneville and Provo, provide most of the sand and gravel utilized in the state. The Bonneville Bench was deposited about 15,000 years ago at an elevation of 5,200 feet above sea level, approximately 1,000 feet above the current Great Salt Lake elevation (Currey and others, 1983).

LIMESTONE AND DOLOMITE

Cambrian to Mississippian Formations provide most of Utah's carbonate rock production. Calcite and aragonite veins, the Tertiary Flagstaff Limestone and the Tertiary Green River Formation and Recent oolites are other sources of present or past production. Seven companies are known to be producing carbonates for the following industrial uses: Genstar Lime (The Flintkote Company) — hydrated lime, quicklime, and crushed stone for road metal and water treatment; Legrand Johnson — crushed stone, limestone for sugar processing; General Dynamics (Utah Marblehead Lime) — hydrated lime; Steele Bros. of Canada (Continental Lime) — quicklime, crushed stone; Cedarstrom Clay and Calcite — poultry grit, livestock feed supplement; U.S. Steel — flux, coal mine rock dust; Utah Calcium — landscaping stone, building stone, poultry grit; and Western Clay Co. — coal mine rock dust.



Texasgulf, Inc. Cane Creek anticline potash mine (1964).

GYPSUM AND ANHYDRITE

Utah has one of the largest gypsum resources in the United States. In 1964 reserves were estimated at 2 billion tons of material averaging more than 85 percent gypsum, in beds with a minimum thickness of 4 feet within 30 feet of the surface. While numerous formations contain gypsum, most of the resource is contained in the Pennsylvanian Paradox Member of the Hermosa Formation and in three Jurassic formations (UGMS, 1964, p. 178). The Jurassic Carmel Formation contains the most extensive resource of all of Utah's occurrences, but production has been mainly from the Jurassic Arapien Shale, with small amounts of gypsite being produced from Recent sediments.

Current gypsum production is by U.S. Gypsum, Georgia Pacific, Thomas J. Peck and Sons, and Cox Enterprises. U.S. Gypsum manufactures wallboard and ready-mix joint compound (Taylor, 1985). Georgia Pacific manufactures wall board, fire-proof doors, plaster, and agricultural gypsum. T.J. Peck and Sons and Cox Enterprises sell most of their gypsum for use as Portland cement retarder. Western Clay purchases some anhydrite which is marketed for coal mine dusting use (Mortensen, 1985).

CLAYS

Utah has an assortment of sedimentary and hydrothermal clays: bentonite, bloating clay, common clay, fire-clay, Fuller's earth, halloysite, and kaolinite are all found in Utah. The three largest producers of clay products in 1983 were Utelite, which produced bloated shale from the Cretaceous Frontier Formation, and Interpace and Interstate Brick which blended clays from different localities to produce heavy clay products (USBM, 1983).

As a part of Interstate Brick's recent expansion program, a new product, Atlas brick (a hollow brick resembling a cinder block in size) is fired in a new tunnel kiln, reputed to be the largest kiln in the western hemisphere. Atlas brick competes against reinforced concrete in the commercial building field. Interstate also recently experimented with a coal gasification pilot plant as a fuel source for their new tunnel kiln.

MISCELLANEOUS COMMODITIES

Other industrial commodities produced in Utah besides the seven just mentioned include crushed stone, dimension stone, gemstones (including red beryl), humates, perlite, and sulfur.

Other Utah commodities which are not known to be currently produced include andalusite, asbestos, barite, beryl, bromine, diatomaceous earth, emery, fluorite, kyanite, lithium, magnesite, pegmatite minerals, pumice, silica refractories, vermiculite, and zeolites.

OUTLOOK

The outlook for industrial commodities in Utah in the near term is mixed. Commodities associated with construction such as Portland cement, common clay, and sand and gravel should do reasonably well considering Utah's above average population growth rate of 2.16 percent per year, projected through 2010 (Utah State Office of Planning and Budget, 1984). Heavy industry-related commodities look much less optimistic. Saline mineral production will obviously be down due to the rise of the Great Salt Lake and to the impact of the current above average precipitation on other solar salt producers.

Manual harvesting of halite on the shores of the Great Salt Lake (early 1900's), Utah Copper Co. (later Kennecott Copper Co.) smelter in background.

UGMS PROGRAM

The UGMS intends to more actively study the industrial mineral resources of the state in hopes of encouraging development of some of these deposits and to facilitate better understanding and management of these resources.

The location of an industrial mineral plant can be a positive benefit to a nearby community. These plants tend to be relatively clean, stable, and long-lived operations which provide significant numbers of jobs. An example is the recent construction of the Martin-Marietta cement plant in Millard County; it brought over 100 new jobs to an economically depressed area of the state (Thompson, 1985).

It is also important to have as much basic industrial mineral resource data as possible to do an adequate job of land-use planning. Industrial minerals do not have the large body of literature available that metals and fuels have so it is easy for these resources to be overlooked in land-use planning decisions such as Project Bold and wilderness area studies.

REFERENCES

Boynton, R.S., 1980, Chemistry and technology of lime and limestone (2d ed.): New York, John Wiley, 578 p.

Burgin, L.B., 1984, The mineral industry of Utah: Preprint from the 1983 Bureau of Mines Mineral Yearbook, 16 p.

Currey, D.R., Atwood G., and Mabey, D.R., 1983, Major levels of Great Salt Lake and Lake Bonneville: Utah Geological and Mineral Survey Map 73.

DeLong, J., 1985, Personal communication: Portland Cement Co. of Utah.

Doelling, H.H., 1983, Mineral resources of Utah *in* Survey Notes: Utah Geological and Mineral Survey, vol. 17, no. 1, p. 9.

Gwynn, J.W.(ed.), 1980, Great Salt Lake, a scientific, historical, and economic overview: Utah Geological and Mineral Survey Bull. 116, 400 p.

Elston, D.P. and Shoemaker, E.M., 1963, Salt anticlines of the Paradox Basin, Colorado and Utah *in* Symposium on Salt: Northern Ohio Geological Society,Cleveland, Ohio, p. 131-146.

Eardley, A.J., 1962, Glauber's salt bed west of Promontory Point, Great Salt Lake: Utah Geological and Mineral Survey Special Studies no. 1.

Day, M., 1985, Personal communication: Questar Corporation.

Hall, R.B., 1985, World nonbauxite aluminum resources - alunite: U.S. Geological Survey Prof. Paper 1076-A, 35 p.

Herod, S., 1982, Martin Marietta's new Utah plant - on line in record time: Pit and Quarry, July 1982, p. 52-60.

Levine, S., 1980, Marblehead Lime expands Utah plant: Pit and Quarry, November 1980, p. 61,63.

Levine, S., 1980, More cement for growing Salt Lake City market area: Pit and Quarry, July 1980.

MacIver, D., 1985, Personal communication: Martin Marietta.

Mortensen, N., 1985, Personal communication: Western Clay Co.

Phillips, M., 1975, Cane Creek Mine solution mining project, Moab potash operations, Texasgulf Inc.: Four Corners Geological Society Guidebook, Eighth Annual Field Conference, Canyonlands, p. 261.

Continued on Page 8

Pratt, H.R., Heylmun, E.B., and Cohenour, R.E., 1966, Salt deposits of Sevier Valley, Utah *in* Second Symposium on Salt: The Northern Ohio Geological Society Inc., Columbus, Ohio, vol. 1, p. 48-58.

Romney, M.P., 1963, Utah's Cinderella minerals: the nonmetallics: Utah Historical Quarterly, vol. 31, no. 3, p. 220-234.

Salt Lake Tribune, 1985, Chevron to move fertilizer plant in 1986: July 2, 1985.

Sommers, D., 1985, Personal communication: Ideal Basic Industries.

Sturm, P.A., 1985, Personal communication: Utah Geological and Mineral Survey.

Thompson, C., 1985, Cement plant escapes hard times: Ogden Standard-Examiner July 21, 1985.

U.S. Bureau of Land Management, 1977, Final environmental statement: proposed alunite project.

U.S. Bureau of Land Management, 1983, Chevron phosphate project - draft environmental impact statement.

U.S. Bureau of Mines, 1985, Mineral producers of Utah: U.S. Bureau of Mines unpublished report.

Utah Geological and Mineral Survey, 1964, Mineral and water resources of Utah: Utah Geological and Mineral Survey Bull. 73, 275 p.

Utah Mining Association, 1985, Management digest: vol. 40, no. 8, Aug. 1985.

Utah State Office of Planning and Budget, 1984, Utah Current Conditions 1984: 22 p.

Utah State Office of Planning and Budget, 1984, 1984 Baseline Projections Executive Summary: 21 p.

Whelan, J.A., 1969, Subsurface brines and soluble salts of subsurface sediments, Sevier Lake, Millard County, Utah: Utah Geological and Mineral Survey Special Studies 30, 13 p.

Wiley, R., 1985, Personal communication: Martin Marietta.

Worthen, L., 1985, Personal communication: Martin Marietta.

FROM THE DIRECTOR'S DESK

Continued from Page 2

the Wasatch Front would be depleted or not available. This inventory has not been updated, however, it is clear that the trends identified in the report were accurate. Few unexploited gravel resources remain unthreatened by urban development and most existing pits are faced with significant neighborhood pressure to close down.

The conflict between residents and gravel pit operations is to be expected. Concerns of residents include: noise, vibration, air pollution, dust, visual degradation, slope instability, landslides, erosion, traffic hazards from trucks, loose gravel on the roads, intrusions into their environment, decreases in their property values, unreclaimed conditions when the pits are abandoned, and, most importantly, hazardous conditions for neighborhood children such as water in the pits, ice in the winter, the steep slopes that can cave in and the dangerous equipment.

Other uses conflict with sand and gravel extraction. Hanggliders are protesting the mining of Point of the Mountain claiming that the recontouring affects wind currents and that the area is unique as a resource for this sport.

The sand and gravel pit industry contends that they have operated in the neighborhood long before residents moved in and that they have improved their extractive techniques to minimize hazards and lessen environmental impacts.

WHAT CAN BE DONE?

Clearly, surface values of an area can exceed the value or potential value of a known resource underlying the area. However, it may also be true that the long-term value of the resource is of regional or state economic significance and may outweigh the short-term benefit of immediate development. The political pressures are strong. Residents are vocal and most zoning ordinances are designed to respond to residential concerns. Resource protection is not often built into planning and zoning regulations.

Thus, although sand and gravel deposits are apparently abundant along the Wasatch Front, the resource that can be developed is scarce. It does not appear that any Wasatch Front community has come to grips with this dilemma. Communities have not defined or evaluated their high-quality sand and gravel deposits, let alone established a means to resolve the conflict between protecting their resources versus protecting their residential environment. Regulations governing sand and gravel pits are not consistent at a federal, state, or county level. Most communities require business licenses, and many communities require special use or conditional use permits. Others require rehabilitation. These regulations tend to be promulgated after the conflicts exist and tend to be drafted to protect the neighborhood from further industrial impacts. What appears to be needed is a recognition at a community policy level that development of these resources is being compromised and a conscious decision of whether or how the community will plan for this. Some communities whose leaders wish to discourage urban growth may be relieved when construction materials become withdrawn from future use. Others may choose to develop incentives or regulations to encourage compatible use or sequential use of the mined out areas. California has instituted such a program called Urban Mineral Land Classification which identifies lands that contain suitable and available aggregate materials and ranks their significance. Then, local governments are reminded of their responsibility as part of their planning actions to provide for local and region needs. Utah is far from taking such statewide action, however, it would seem advisable for communities to recognize this dilemma, identify their precious resources, and plan accordingly. These resources are not difficult to identify. In some areas, extraction of the resource could preceed urban development. In others, that many not be possible and the resource will be buried. That seems preferable to what appears to be taking place today...the alienation of a potential resource with apparently little thought for long-term needs of the community.

Credits: Much of the factual content of this article was provided by Fitzhugh Davis and Bryce Tripp, UGMS staff.

Genevieve Atwood

GREAT SALT LAKE LEVEL

Date (1985)	Boat Harbor South Arm (in feet)	Saline North Arm (in feet)
June 1*	4209.90	4209.05
June 15*	4209.80	4209.00
July 1	4209.55	4208.85
July 15	4209.40	4208.65
Aug 1	4209.15	4208.30
Aug 15	4208.85	4208.10
Sept 1	4208.65	4207.90
Sept 15	4208.50	4207.70
Oct 1	4208.45	4207.55
Oct 15	4208.40	4207.50

Source: USGS provisional records.
* Spring issue March levels were incorrect.

CUSMAP — Mineral Assessment

By DON R. MABEY

THE Utah Geological and Mineral Survey (UGMS) and the U.S. Geological Survey (USGS) have begun an appraisal of the mineral resources of the Delta 1 X 2 degree quadrangle covering about 8,000 square miles in Millard, Juab, and Tooele Counties with small areas in Utah, Sanpete, and Sevier Counties. The program, which is part of the USGS Conterminous United States Mineral Assessment Program, or CUSMAP, will be completed in four years. Products from the program are a new geologic map of the area, maps showing geochemical and geophysical anomalies, mineral occurrences, and mineral potential and reports containing data and mineral resources information. Extensive use will be made of remote sensing data from aircraft and satellite. Much of the data obtained will be computerized. The program will be staffed by geologists, geophysicists and geochemists from the UGMS office in Salt Lake City and USGS offices: Denver, Colorado; Menlo Park, California; Reston, Virginia; and Sioux Falls, South Dakota.

The study area includes districts that have produced important amounts of minerals in the past, such as the Tintic Mining District at Eureka and the Brush-Wellman beryllium mine at Spor Mountain, as well as areas that appear favorable for the discovery of new resources. Much of the quadrangle is covered with young sediments that conceal older rocks containing the mineral deposits, therefore, evaluating the resources underlying these covered areas will be a major goal of the program. A meeting of UGMS and USGS personnel involved in the program was held in Salt Lake City on October 23 to develop final plans for the program. This was followed by a field trip into the area on October 24.

Genevieve Atwood, UGMS Director and State Geologist, said "This program will provide information useful to the mineral industry of Utah in the search for new mineral deposits. The program will also provide to both State and Federal agencies information on resources that is needed for land-use decisions. The program is an excellent example of State and Federal agencies working together on joint problems."

A similar program in the recent past produced a series of highly informative maps and related publications for the Richfield 1 X 2 degree area, adjoining the Delta area's southern border.

UTAH HAZARDS CONFERENCE

The Proceedings of a Conference held at Utah State University last year are now available. "Delineation of Landslide, Flash Flood, and Debris Flow Hazards in Utah" can be obtained for $30 payable to Utah Water Research Laboratory. Order from Publications, Utah Water Research Laboratory, Utah State University, Logan UT 84322-8200.

Belated credit is due to Dan A. Foster of the Utah Division of State Lands and Forestry for the digitized mine map on last issue's cover. It's available in the Utah AGR ARC/INFO data base.

NEW PUBLICATIONS

Reports of Investigation

Report of Investigation 200, *Mineral occurrences in the emergency withdrawal areas and adjacent lands in the Great Salt Lake Desert,* by J.W. Gwynn, K. Clem, M. Shubat and B. Tripp, 1985.

Report of Investigation 201, *The Hill Creek oil-impregnated sandstone deposit,* by J.W. Gwynn, 1985, 38 pages.

Report of Investigation 202, *UGMS Involvement with Paradox Basin repository siting,* by S.N. Eldredge and G. Atwood, 1985, 69 pages.

Open File Reports

Open File Report 74, *Computerized index of the bibliography of Utah geology,* vols. 1 and 2, 1985.

Open File Report 77, *Computerized index of the bibliography of Utah geology,* vols. 3 through 8, 1985.

Open File Report 82, *Significant boreholes of the Wasatch Front Valleys including Cache Valley and Tooele Valley,* by W.F. Case, 1985, 178 pages.

Maps

Map 76, *Geologic map and coal resources of the Deadman Canyon quadrangle, Carbon County, Utah,* by M.A. Nethercott, 1985, scale 1:24,000, 20 pages, 2 plates.

Map 92, *Generalized geologic map of Utah,* by H.H. Doelling, 1985. Full-color postcard of Utah's geology.

UGMS COAL ACTIVITY

1. National Coal Resource Data System (NCRDS) project to collect, computerize and interpret coal data as a basis for management of Utah's coal resources and for informed policy decisions.
2. Coal sampling program—collection and analysis of coal samples from active and inactive mines.
3. Petrographic coring program—collection and analysis of coal samples collected from drill holes in areas of little or no data, to test for rank, maceral intensity, methane content. Data to be computerized and maps prepared to show rank, maceral content, chemical content.
4. Henry Mountains Coal Folio—part of on-going program to prepare regional and detailed maps of all Utah coal fields.
5. Coal sample bank (proposed)—cooperative with the University of Utah to preserve and analyze coal samples.
6. Student mapping project—a number of geologic quadrangle maps are being prepared in Carbon County coal fields for publication by the UGMS.

ENERGY SECTION ANNOUNCES NEW ARRIVAL: MICROCOMPUTER

By Cynthia Brandt and Keith Clem

DURING this past summer the Energy Section of the UGMS purchased an AT-compatible microcomputer. For many reasons, geologists and staff alike are quite happy with this new arrival. It has a high-resolution color monitor which is ideal for graphics and it is also very fast, about 33% faster than the industry standard. Storage and memory are similarly exceptional with a 30 megabyte fixed disk storage, a 1.2 megabyte floppy disk drive storage, and a 512K random access memory which is expandable to 8 megabytes. To those of us who don't speak computer-ese, this computer can hold a lot of information.

But perhaps what is most exciting about this new computer is its ability to grow. Unlike most microcomputers, this one can have more than one terminal connected to it at once. In fact, it can support up to 11 terminals at once. The hope is that in the near future 11 choice offices will be the happy, working home of a terminal.

For the present, however, the Energy Section has a long list of assignments for the new computer and its one terminal. The Petroleum Group is particularly interested in this microcomputer's abilities. They are in the process of acquiring a database for all wells drilled in Utah. Once that is stored in the computer, database management software will work miracles on unraveling the massive quantities of data accumulated about Utah's petroleum resources. Information will then be more easily and more quickly retrieved, organized, and compiled. The output of the information can also take on different forms, including text, tables, graphs, and maps. The possibilities are varied because the new computer is able to converse in fluent terms with other new arrivals—a dot matrix, high-speed printer; a 6-pen graphics plotter; a large-format digitizer; and a large-format plotter.

The coal, uranium, and geothermal groups of the Energy Section have plans for the new computer which are similar in scope to the petroleum group's, but they may need to line up to use it. Many staff members of the UGMS already have their eyes on the new microcomputer. The people working in the Sales Office want to track the marketing of publications and, of course, sales tax collected. Color graphic displays of the number and type of publications and the revenues each month and year may come to be common fixtures around the UGMS. Further plans are to put cross references for publications into the computer in addition to the complete inventory of publications. Don't be surprised if you call the Survey one day to inquire about UGMS publications and you get an answer before you finish your question. This new microcomputer is not only versatile, but it is also truly fast.

As a final note, if anyone would like to contribute a database to the UGMS, the Survey will certainly be interested. Any software will also be welcomed with open arms. This new arrival is quite capable, but it needs information and guidance in order for it to realize its full potential.

VOLCANIC HAZARDS

By DON R. MABEY

THE eruption of Nevado del Ruiz volcano in Columbia on November 13, 1985, and the resulting death of approximately 25,000 people, is the most recent example of the destructive power of volcanos and the potential they have to cause large loss of life. It is estimated that world wide over 200,000 people have been killed by volcanic eruptions since 1500 A.D. Volcanic eruptions are not generally considered a major hazard to Utah but they do pose a threat that should not be completely ignored.

There are no active volcanos in Utah of the type that cause widespread destruction. Several million years have passed since Utah experienced this kind of an eruption and there is no reason to believe that one will occur in the future. However, much milder volcanic eruptions have occurred in southwestern Utah in recent geologic time. The most volcanically active area of Utah extends north from the Beaver-Milford area to the Pavant Valley west of Fillmore. In the last million years, flows of basalt have covered several hundred square miles and small eruptions of rhyolite have occurred. The youngest of the basalt flows, which is west of Milford, has been tentatively dated on the basis of a root underlying the flow having a radio-carbon age between 490 and 830 years. At some time in the future basalt will likely again erupt and flow over the floor of Pavant Valley. Well in advance of an eruption, small earthquakes will likely warn us that lava is moving toward the surface. Damage to property in this sparsely populated area should not be great and the relatively slow movement of the flows across the valley should allow adequate time to evacuate all people from the effected area.

A more serious threat to Utah is from volcanos to the west in California, Oregon and Washington. Explosive eruptions of the type that occurred at Mt. St. Helens in 1980 but perhaps much larger could blow huge volumes of ash into the atmosphere and, with the proper wind direction, a significant blanket of ash would be deposited on Utah. A major eruption in Long Valley, California on the east side of the Sierra Nevada 700,000 years ago deposited ash over all of Utah with thicknesses up to several inches. Ash deposits from other volcanic eruptions to the west and in Yellowstone Park area are found in Utah. In 1983 when earthquakes and doming of the land surface in Long Valley area of California suggested that another volcanic eruption might occur there, the U.S. Geological Survey (USGS) issued a warning and sent a geologist to Utah to brief state and local government officials on the hazard to Utah. The USGS warned that ash falls at this distance from an eruption generally endanger property more than human life. They indicated that prob-

VOLCANIC HAZARDS
Continued from Page 10

lems of concern were roof collapse, reduced visibility, damage to machinery by clogging filters and rapid wear of moving parts, short circuits of electrical systems and the clogging of water and air filters, which could disable water, sewer and ventilation systems. The activity in Long Valley has declined and the warning has been cancelled.

A more common impact on Utah of volcanic eruptions is that the ash blown into the atmosphere circles the earth and affects the weather for many months. The normal result is a general cooling and significant alteration of normal weather patterns. Several people have suggested a correlation between world-wide volcanic activity and rises in the level of Great Salt Lake.

Aside from the effects on weather, volcanic eruptions that directly affect Utah are very rare and events preceding these eruptions would likely provide considerable warning. No major actions seem justified now in anticipation of eruptions that may not occur for thousands of years. Rather, we should work to obtain a better understanding of all active volcanic sustems and how they might affect Utah and assume that with this knowledge we will have adequate warning to take appropriate actions when an eruption appears imminent.

UGMS STAFF CHANGES

The following staff changes have taken place since last issue:

Kimm M. Harty, and **Suzanne Hecker** are Hazards Geologists with the Site Investigation Section. Kimm, who was a geotechnician in Site for one year, received her M.Sc. in Geomorphology from University of Alberta, while Suzanne has a M.Sc. in Quaternary Studies from the University of Arizona.

The new Mapping Geologist, **Mark E. Jensen,** has been with Amselco Exploration, Inc., and has a M.Sc. from Brigham Young University.

A belated welcome to **John S. Hand** our new Computer Geologist, whose byte is worse...

Sharon Wakefield has joined UGMS to bolster Administration's clerical staff, while **Leigh MacManus** is the new typesetter/graphic designer, replacing **Cathy Pinch** who was the mainstay of Survey Notes, but has returned for more schooling in Illinois.

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UTAH EARTHQUAKE ACTIVITY

July through September 1985

By ETHAN D. BROWN

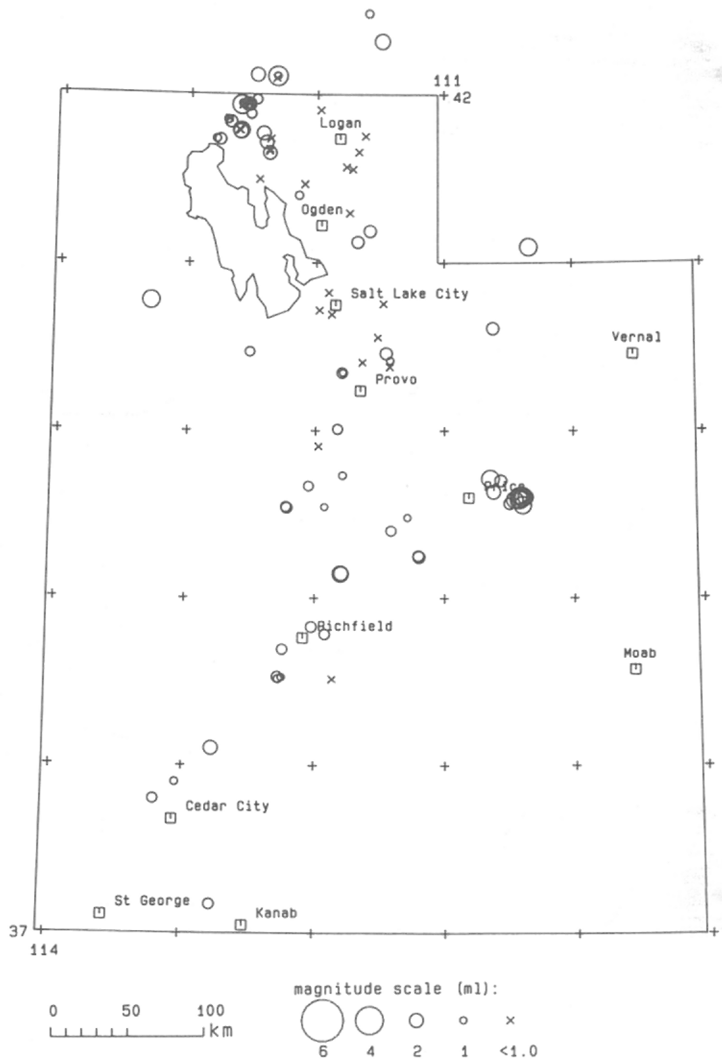
UNIVERSITY OF UTAH SEISMOGRAPH STATIONS
DEPARTMENT OF GEOLOGY AND GEOPHYSICS

THE University of Utah Seismograph Stations records an 80-station seismic network designed for local earthquake monitoring within Utah, southeast Idaho, and western Wyoming. During July 1 to September 30, 1985, 99 earthquakes were located within the Utah region (figure 1). The largest earthquake during this time period, M_L 2.8, occurred just north of the Utah-Idaho border on August 7, 1985, and was felt at Samaria and Malad City, Idaho. During the report period, four larger earthquakes occurred within the University of Utah regional seismic network, but to the north of the Utah region near Alpine, Wyoming: M_L 4.3 on August 16, M_L 4.6 on August 21, M_L 4.3 on August 22, and M_L 4.3 on August 30.

Significant clusters of earthquake activity during the report period shown in figure 1 include:

1) thirty-two earthquakes north of the Great Salt Lake ($M_L \leq 2.8$).
2) fourteen earthquakes east of Price in an area of active underground coal mining ($M_L \leq 2.8$).

Additional information on earthquakes within Utah is available from the University of Utah Seismograph Stations, Salt Lake City, Utah 84112 (telephone 801-581-6274).



Utah Earthquakes: July 1 - September 30, 1985

UTAH NATURAL RESOURCES
Utah Geological and Mineral Survey
606 Black Hawk Way
Salt Lake City Utah 84108-1280